

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

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1 A reduced near-infrared radiation transmitting, reduced ultraviolet radiation transmitting, electrochromic glazing assembly comprising:

5 first and second spaced, optically transparent, elements, said elements each having outside and inside surfaces and defining a space between the outside surface of said first element and the inside surface of said second element;

10 an electrochromic medium confined in said space whose light transmittance is variable upon the application of an electric field thereto;

means for applying an electric field to said electrochromic medium to cause variation in the light transmittance of said medium;

15 ultraviolet radiation reducing means incorporated in said assembly for reducing ultraviolet radiation degradation of said electrochromic medium in said assembly and for reducing ultraviolet radiation transmittance through said assembly; and

20 near-infrared reflective means located on at least one of said first and second elements for reducing the transmission of near-infrared radiation through said window assembly, said reflective means incorporating at least one semitransparent, elemental, thin metal film;

25 said elemental thin metal film reflecting at least about 30% of the solar energy for Air Mass 2 in the spectral region from 800 nanometers to 2500 nanometers.

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1        The glazing assembly of claim 1 wherein said  
elemental thin film has a physical thickness of from about  
80 angstroms to about 300 angstroms.

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1        The glazing assembly of claim 2 wherein said  
elemental thin film has a sheet electrical resistance of no  
greater than about 8 ohms/square.

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1        The glazing assembly of claim 3 wherein said  
elemental thin metal film is selected from the group  
consisting of gold, copper, aluminum, silver, and alloy  
combinations thereof.

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1        The glazing assembly of claim 3 wherein said  
elemental thin metal film is silver.

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1        The glazing assembly of claim 5 wherein said  
near-infrared reflective means is a thin film stack  
including said elemental thin metal film sandwiched between  
optically transparent thin metal compound films selected  
5        from the group consisting of metal oxide, metal nitride,  
metal halide, and metal sulfide thin films.

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1        The glazing assembly of claim 6 wherein said thin  
metal compound films of said thin film stack are selected  
from the group consisting of zinc oxide, titanium oxide,  
vanadium oxide, zirconium oxide, tungsten oxide, indium  
oxide, bismuth oxide, magnesium fluoride, cerium oxide,  
5        indium/tin oxide, tin oxide, zinc sulfide, silicon oxide and  
silicon nitride.

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1           The glazing assembly of claim 1 wherein said  
near-infrared reflective means is a thin film stack  
including said elemental thin metal film sandwiched between  
optically transparent thin metal compound films selected  
5           from the group consisting of metal oxide, metal nitride,  
metal halide, and metal sulfide thin films.

1           The glazing assembly of claim 8 wherein said thin  
metal compound films of said thin film stack are selected  
from the group consisting of zinc oxide, titanium oxide,  
vanadium oxide, zirconium oxide, tungsten oxide, indium  
5           oxide, bismuth oxide, magnesium fluoride, cerium oxide,  
indium/tin oxide, tin oxide, zinc sulfide, silicon oxide and  
silicon nitride.

1           The glazing assembly of claim 1 further comprising  
spectrally selective absorbing means for absorbing more  
light in those regions of the visible spectrum from about  
560 nanometers to about 780 nanometers than is absorbed in  
5           those regions of the visible spectrum from about 400  
nanometers to about 560 nanometers.

1           The glazing assembly of claim 1 wherein at least  
one of said elements is formed from specialized glass which  
absorbs substantially more visible light in wavelengths  
higher than about 560 nanometers than in other regions of  
5           the visible spectrum and has a blue tint.

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1        The glazing assembly of claim 11 wherein said specialized blue tint glass is the outermost or outside element in the window assembly.

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1        The glazing assembly of claim 11 wherein said specialized blue tint glass element is the innermost or inside element in the window assembly.

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1        The glazing assembly of claim 1 wherein at least one of said elements incorporates a UV absorbing glass sheet comprising at least 0.2 weight percent of one of cerium oxide, iron oxide and titanium dioxide.

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1        The glazing assembly of claim 1 wherein said second element is a laminate assembly adapted to be closer to the exterior of the vehicle in which said assembly is mounted and including first and second spaced, optically 5 transparent panels, said panels each having outside and inside surfaces and secured to one another by an intermediate layer.

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1        The glazing assembly of claim 15 wherein said near-Infrared reflector is located between said first and second panels.

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1        The glazing assembly of claim 16 wherein at least one of said panels is formed from highly light transmitting glass.

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1        The glazing assembly of claim 15 wherein at least  
one panel in said laminate assembly is specialized blue tint  
glass.

1        The glazing assembly of claim 15 wherein at least  
one of said glass panels is formed from tempered safety  
glass.

1        The glazing assembly of claim 15 further  
comprising spectrally selective absorbing means for  
absorbing more light in those regions of the visible  
spectrum from about 560 nanometers to about 780 nanometers  
5        than is absorbed in those regions of the visible spectrum  
from about 400 nanometers to about 560 nanometers.

1        The glazing assembly of claim 26 wherein said  
spectrally selective absorbing means also include a  
polymeric interlayer which is highly light transmitting and  
which adheres said panels to one another.

1        The glazing assembly of claim 27 wherein said  
polymeric interlayer is a sheeting layer which absorbs  
substantially more visible light in wavelengths higher than  
about 560 nanometers than in other regions of the visible  
5        spectrum and has a blue tint.

1        The glazing assembly of claim 1 wherein said  
assembly is one of a vehicle window, vehicle sunroof, a  
vehicle sun visor, and a vehicle shade band.

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1           The glazing assembly of claim 1 wherein said  
assembly includes a perimetral coating on at least one  
surface of at least one of said elements for concealing from  
view said means for applying an electric field to said  
5           electrochromic medium.

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1           The glazing assembly of claim 1 wherein said  
assembly includes seal means intermediate said elements for  
confining said electrochromic medium in said space; said  
seal means being color matched to structure in the vehicle  
5           which is adjacent said assembly.

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1           The glazing assembly of claim 1 wherein said first  
element is a laminate assembly adapted to be closer to the  
interior of the vehicle in which said assembly is mounted  
and including first and second spaced, optically transparent  
5           panels, said panels each having outside and inside surfaces  
and secured to one another by an intermediate layer.

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1           The glazing assembly of claim 32 wherein said  
near-infrared reflector is located between said first and  
second panels.

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1           The glazing assembly of claim 32 wherein said one  
glass panel is formed from highly light transmitting  
specialized glass which absorbs substantially more visible  
light in wavelengths higher than about 560 nanometers than  
5           in other regions of the visible spectrum and has a blue  
tint.

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1        The glazing assembly of claim 32 wherein said  
intermediate layer comprises an optically transparent  
polymeric adhesive substance having scatterproofing,  
anti-lacerative and spectrally selective absorbing  
5        characteristics, and said ultraviolet radiation reducing  
means incorporated therein.

1        The glazing assembly of claim 35 wherein at least  
one of said glass panels is formed from tempered safety  
glass.

1        The glazing assembly of claim 32 further  
comprising spectrally selective absorbing means for  
absorbing more light in those regions of the visible  
spectrum from about 560 nanometers to about 780 nanometers  
5        than is absorbed in those regions of the visible spectrum  
from about 400 nanometers to about 560 nanometers.

1        A reduced near-infrared radiation transmitting,  
reduced ultraviolet radiation transmitting, electrochromic  
glazing assembly comprising:

5        first and second spaced, optically transparent,  
elements, said elements each having outside and inside  
surfaces and defining a space between the outside surface of  
said first element and the inside surface of said second  
element, one of said elements being a laminated assembly  
including first and second spaced, optically transparent  
10      panels, said panels each having outside and inside surfaces  
and secured to one another by an intermediate layer;

an electrochromic medium confined in said space whose light transmittance is variable upon the application of an electric field thereto;

15 means for applying an electric field to said electrochromic medium to cause variation in the light transmittance of said medium;

20 ultraviolet radiation reducing means incorporated in said assembly for reducing ultraviolet radiation degradation of said electrochromic medium in said assembly and for reducing ultraviolet radiation transmittance through said assembly; and

25 near-infrared reflective means located on at least one of said first and second elements for reducing the transmission of near-infrared radiation through said window assembly, said reflective means incorporating at least one semitransparent, elemental, thin metal film;

30 said elemental thin metal film reflecting at least about 30% of the solar energy for Air Mass 2 in the spectral region from 800 nanometers to 2500 nanometers.

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1 The glazing assembly of claim 38 wherein said elemental thin metal film has a physical thickness of between about 80 angstroms to about 300 angstroms.

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1 The glazing assembly of claim 39 wherein said elemental thin metal film has a sheet electrical resistance of no greater than about 8 ohms/square.

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1 The glazing assembly of claim 40 wherein said elemental thin metal film is selected from the group

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consisting of gold, copper, aluminum, silver, and alloy combinations thereof.

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1 The glazing assembly of claim 40 wherein said elemental thin metal film is silver.

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1 The glazing assembly of claim 38 wherein said near-infrared reflective means is a thin film stack including said elemental thin metal film sandwiched between optically transparent thin metal compound films selected 5 from the group consisting of metal oxide, metal nitride, metal halide, and metal sulfide thin films.

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1 The glazing assembly of claim 43 wherein said thin metal compound films of said thin film stack are selected from the group consisting of zinc oxide, titanium oxide, vanadium oxide, zirconium oxide, tungsten oxide, indium oxide, bismuth oxide, magnesium fluoride, cerium oxide, 5 indium/tin oxide, tin oxide, zinc sulfide, silicon oxide and silicon nitride.

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1 The glazing assembly of claim 38 further comprising spectrally selective absorbing means for absorbing more light in those regions of the visible spectrum from about 560 nanometers to about 780 nanometers 5 than is absorbed in those regions of the visible spectrum from about 400 nanometers to about 560 nanometers.

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1 The glazing assembly of claim 45 wherein at least one of said panels is formed from highly light transmitting glass.

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1        The glazing assembly of claim 45 wherein one of  
said glass panels is formed from specialized glass which  
absorbs substantially more visible light in wavelengths  
higher than about 560 nanometers than in other regions of  
5        the visible spectrum and has a blue tint.

1        The glazing assembly of claim 38 wherein said  
near-infrared reflector is located between said first and  
second panels of said one element.

1        The glazing assembly of claim 38 wherein said  
intermediate layer comprises an optically transparent  
polymeric adhesive substance having scatterproofing and  
spectrally selective absorbing characteristics, and said  
5        ultraviolet radiation reducing incorporated therein.

1        The glazing assembly of claim 38 wherein said  
intermediate layer is a sheeting layer which absorbs  
substantially more visible light in wavelengths higher than  
about 560 nanometers than in other regions of the visible  
5        spectrum and has a blue tint.

1        The glazing assembly of claim 38 wherein at least  
one of said elements incorporates a UV absorbing glass sheet  
comprising at least 0.2 weight percent of one of cerium  
oxide, iron oxide and titanium dioxide.

1        The glazing assembly of claim 38 wherein at least  
one of said panels includes a layer of UV radiation reducing  
polymeric film on at least one surface thereof.

1        The glazing assembly of claim 52 wherein said  
polymeric film is on a surface of said assembly adapted to  
face the interior of the vehicle in which said assembly is  
mounted, said polymeric film including anti-misting means  
5        for reducing fogging thereon.

1        The glazing assembly of claim 38 wherein at least  
one of said glass panels is formed from tempered safety  
glass.

1        The glazing assembly of claim 38 wherein said  
assembly includes a perimetral coating on at least one  
surface of at least one of said elements for concealing from  
view said means for applying an electric field to said  
5        electrochromic medium.

1        The glazing assembly of claim 38 wherein said  
assembly includes seal means intermediate said elements for  
confining said electrochromic medium in said space; said  
seal means being color matched to structure in the vehicle  
5        which is adjacent said assembly.

1        A reduced near-infrared radiation transmitting,  
reduced ultraviolet radiation transmitting, safety-protected  
electrochromic vehicular glazing assembly comprising:  
5        first and second spaced, optically transparent,  
elements, said elements each having outside and inside  
surfaces and defining a space between the outside surface of  
said first element and the inside surface of said second  
element, said second element being a laminate assembly

adapted to be closer to the exterior of the vehicle in which  
10 said assembly is mounted and including first and second  
spaced, optically transparent panels, said panels each  
having outside and inside surfaces and secured to one  
another by an intermediate layer;

15 an electrochromic medium confined in said space  
whose light transmittance is variable upon the application  
of an electric field thereto;

means for applying an electric field to said  
electrochromic medium to cause variation in the light  
transmittance of said medium;

20 ultraviolet radiation reducing means incorporated  
in said assembly for reducing ultraviolet radiation  
degradation of said electrochromic medium in said assembly  
and for reducing ultraviolet radiation transmittance through  
said assembly;

25 safety means incorporated in said assembly for  
preventing fragment scattering, lacerative injuries and  
contact with said electrochromic medium should one of said  
elements break or crack; and

30 near-infrared reflective means located on at least  
one of said first and second elements for reducing the  
transmission of near-infrared radiation through said window  
assembly, said reflective means incorporating at least one  
semitransparent, elemental, thin metal film.

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1 The glazing assembly of claim 57 wherein said  
elemental, thin metal film has a physical thickness of  
between about 80 angstroms to about 300 angstroms.

1 The glazing assembly of claim 58 wherein said elemental thin metal film has a sheet electrical resistance of no greater than about 8 ohms/square.

1 The glazing assembly of claim 59 wherein said safety means includes a layer of said UV radiation reducing polymeric film on a surface of at least one of said elements.

1 The glazing assembly of claim 60 wherein said near-infrared reflective means is located between said first and second panels of said second element.

1 The glazing assembly of claim 61 wherein said elemental thin metal film of said near-infrared reflective means is selected from the group consisting of gold, copper, aluminum, silver, and alloy combinations thereof.

1 The glazing assembly of claim 61 wherein said elemental thin metal film is silver.

1 The glazing assembly of claim 61 wherein said near-infrared reflective means is a thin film stack including said elemental thin metal film sandwiched between optically transparent thin metal compound films selected from the group consisting of metal oxide, metal nitride, metal halide, and metal sulfide thin films.

1 The glazing assembly of claim 64 wherein said thin metal compound films of said thin film stack are selected

from the group consisting of zinc oxide, titanium oxide, vanadium oxide, zirconium oxide, tungsten oxide, indium oxide, bismuth oxide, magnesium fluoride, cerium oxide, indium/tin oxide, tin oxide, zinc sulfide, silicon oxide and silicon nitride.

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1 The glazing assembly of claim 61 further comprising spectrally selective absorbing means for absorbing more light in those regions of the visible spectrum from about 560 nanometers to about 780 nanometers  
5 than is absorbed in those regions of the visible spectrum from about 400 nanometers to about 560 nanometers.

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1 The glazing assembly of claim 66 wherein at least one of said panels is formed from highly light transmitting glass; said glass panel including said spectrally selective absorbing means, said glass panel being formed from  
5 specialized glass which absorbs substantially more visible light in wavelengths higher than about 560 nanometers than in other regions of the visible spectrum and has a blue tint.

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1 The glazing assembly of claim 67 wherein said specialized blue tint glass panel is the outermost or outside panel in said laminate assembly.

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1 The glazing assembly of claim 66 wherein said intermediate layer is a polymeric layer incorporating said safety means, said spectrally selective absorbing means, and said ultraviolet radiation reducing means therein.

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1        The glazing assembly of claim 69 wherein said  
polymeric layer absorbs substantially more visible light in  
wavelengths higher than about 560 nanometers than in other  
regions of the visible spectrum and has a blue tint.

1        The glazing assembly of claim 57 wherein said  
safety means includes a polymeric layer on one surface of  
one of said elements having at least one of anti-lacerative  
and anti-misting characteristics.

1        The glazing assembly of claim 57 wherein at least  
one of said panels of said laminate assembly has a blue  
tint.

1        The glazing assembly of claim 57 wherein at least  
one of said elements incorporates a UV absorbing glass sheet  
comprising at least 0.2 weight percent of one of cerium  
oxide, iron oxide and titanium dioxide.

1        The glazing assembly of claim 57 wherein said  
assembly includes a perimetral coating on at least one  
surface of at least one of said elements for concealing from  
view said means for applying an electric field to said  
5        electrochromic medium.

1        The glazing assembly of claim 57 wherein said  
assembly includes seal means intermediate said elements for  
confining said electrochromic medium in said space; said  
seal means being color matched to structure in the vehicle  
5        which is adjacent said assembly.